CLAIMS

What is claimed is:

1. A method for forming a contact electrically connected to a metal line, comprising:

forming an insulation layer situated on a semiconductor substrate;

forming a contact hole in the insulation layer to expose a contact surface on said semiconductor substrate; and

forming a single layer of metal having a substantially planar top surface upon a top planar surface of said insulation layer, said single layer of metal substantially filling the contact hole and being in electrical contact with said contact surface on said semiconductor substrate.

2. The method of claim 1, wherein the single layer of metal comprises a pure metal or alloy thereof.

3. The method of claim 1, wherein the single layer of metal comprises a material selected from the group consisting of Al, AlCu, and AlCuSi.

4. The method of claim 1, wherein the single layer of metal comprises a material selected from the group consisting of AlSi, AlTi, AlAg, AlAu, AlMn, AlNa, AlW, AlCuZn, and AlNi.

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5. The method of claim 1, wherein the insulation layer comprises a material selected from the group consisting of TEOS, doped silicon dioxide, BPSG, PSG, BSG, and silicon nitride.

6. The method of claim 1, wherein the insulation layer comprises a material selected from the group consisting of oxides, nitrides, carbides, carbon nitrides, oxynitrides, doped monocrystalline silicon, and doped polycrystalline silicon.

7. The method of claim 1, wherein the step of forming a single layer of metal having a substantially planar top surface upon a top planar surface of said insulation layer comprises:

planarizing the insulation layer to form said top planar surface of said insulation layer;

depositing said single layer of metal upon said top planar surface of said insulation layer, said single layer of metal having a selected thickness;

treating said semiconductor substrate in an environment of a selected pressure range and a selected temperature range so as to cause said single layer of metal to substantially fill the contact hole;

planarizing the single layer of metal; and

forming a metal line having a selected shape from said single layer of metal.

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8. The method of claim 7, wherein forming a metal line having selected shape from said single layer of metal comprises patterning and etching said single layer of metal into said metal line having said selected shape.

9. The method of claim 1, wherein forming a single layer of metal having a substantially planar top surface upon a top planar surface of said insulation layer comprises:

planarizing the insulation layer to form said top planar surface of said insulation layer;

forming a refractory metal silicide layer within said contact hole upon said contact surface on said semiconductor substrate, said contact surface comprising silicon;

forming a refractory metal nitride layer upon a sidewall of said contact hole in contact with said insulation layer;

depositing said single layer of metal upon said top planar surface of said insulation layer and in contact with both said refractory metal silicide layer and said refractory metal nitride layer; and

treating said semiconductor substrate in an environment of a selected pressure range and a selected temperature range so as to cause said single layer of metal to substantially fill the contact hole.

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10. The method of claim 9, wherein said refractory metal silicide layer comprises titanium silicide and said refractory metal nitride layer is comprised at least in part of titanium nitride.

11. The method of claim 1, wherein forming a single layer of metal is selected from the group of deposition processes consisting of PVD, CVD, electroplating, and electroless plating.

12. A method for forming a contact electrically connected to a metal line, comprising:

forming an insulation layer situated on a silicon layer upon a semiconductor substrate;

forming a contact hole in the insulation layer to expose a contact surface on said silicon layer;

forming a refractory metal silicide layer within said contact hole upon said silicon layer;

forming a refractory metal nitride layer upon a sidewall of said contact hole in contact with said insulation layer;

depositing a single layer of metal upon said insulation layer and in contact with both said refractory metal silicide layer and said refractory metal nitride layer; and

treating said semiconductor substrate in an environment of a selected pressure range and a selected temperature range so as to cause said single layer of metal to substantially fill the contact hole.

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13. The method of claim 12, further comprising:

planarizing the single layer of metal; and

patterning and etching said single layer of metal into a metal line having a selected shape.

14. The method of claim 12, wherein the single layer of metal comprises a material selected from the group consisting of Al, AlCu, and AlCuSi, and the insulation layer comprises a material selected from the group consisting of TEOS, doped silicon dioxide, BPSG, PSG, BSG, and silicon nitride.

15. A contact plug and metallization line structure comprising:

a semiconductor substrate having a contact surface thereon;

an insulation layer having a contact hole therethrough extending to the contact surface on the semiconductor substrate;

a plug comprised of a first metal and situated in said contact hole, said plug being electrically insulated by said insulation layer; and

a metallization line comprised of a second metal, wherein said plug and said metallization line are electrically connected and have a substantially continuous composition gradient of a selected alloying element between said first metal and said second metal;

wherein the contact surface has a first refractory metal silicide layer thereon in contact with a first end of said plug.

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16. The contact plug and metallization line structure of claim 15, wherein each of said first and second metals is selected from the group consisting of Al, AlCu, and AlSiCu, and wherein one of said first and second metals has a higher concentration of Cu than the other of said first and second metals.

17. The contact plug and metallization line structure of claim 15, wherein the first and second metals have substantially the same composition.

18. The contact plug and metallization line structure of claim 15, wherein said plug has a second end opposite said first end and in contact with a second refractory metal silicide layer, said second refractory metal silicide layer being in contact with said metallization line.

19. A contact plug and metallization line structure comprising:

a semiconductor substrate having a contact surface thereon;

an insulation layer comprising a doped oxide of silicon and having a contact hole therethrough extending to the contact surface on the semiconductor substrate;

a plug comprised of a first metal and situated in said contact hole, said first metal being selected from the group consisting of aluminum and alloys thereof, said plug being electrically insulated by said insulation layer; and

a metallization line comprised of a second metal, said second metal being selected from the group consisting of aluminum and alloys thereof, wherein said plug and said metallization line are electrically connected and have

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a substantially continuous composition gradient of a selected alloying element between said first metal and said second metal;

wherein the contact surface has a first refractory metal silicide layer thereon in contact with a first end of said plug.

20. The contact plug and metallization line structure of claim 19, wherein the first and second metals comprise a material selected from the group consisting of AlSi, AlTi, AlAg, AlAu, AlMn, AlNa, AlW, AlCuZn, and AlNi.

21. The contact plug and metallization line structure of claim 19, wherein the insulation layer comprises a material selected from the group consisting of oxides, nitrides, carbides, carbon nitrides, oxynitrides, doped monocrystalline silicon, and doped polycrystalline silicon.

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